

~~Cooling Device~~

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Patent Application

of

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for

COOLING DEVICE

#### Field of the Invention

The present invention relates to a cooling device comprising a cooling unit through which a fluid to be cooled, in particular hydraulic oil, can flow, ~~the~~. ~~The unit having has~~ a device housing and at least one filter unit for filtration of the fluid.

#### Background of the Invention

These cooling devices can be used for a plurality of applications, and are available in the most varied embodiments. The cooling device systems ~~which have been~~ freely available on the market to date however all ~~consist have~~ either of a filter unit ~~which is~~ flanged to the cooling unit, or of tank units ~~which are~~ connected to the cooling units, with the respective tank unit ~~then~~ holding the filter element. The known cooling devices are therefore generally ~~composed~~ formed of several

components, and the. The actual cooling unit can be connected by way of the corresponding piping to the actual filter unit as the cooling device is being produced. Here it cannot be precluded that ~~misconnections~~ Misconnections can then occur in the indicated piping, and consequently malfunction sources occur in the installation of the known cooling devices. Furthermore, the known cooling device solutions are structurally large due to the diversity of their parts and accordingly heavy; ~~this~~. This characteristic is especially disadvantageous for mobile use.

~~Accordingly, in~~ In the known cooling device according to WO 01/65123 A1 ~~it has already been suggested that~~, the cooling unit and the filter unit ~~be~~ are combined with each other in one piece, ~~the~~. The filter unit together with the cooling unit ~~being~~ is located in a device housing, ~~so that avoiding a multipiece construction is avoided, and the~~. The known cooling device can be made much more compact and light with the same performance. By integrating the cooling unit and filter unit in one device housing ~~moreover~~, the conventional piping can be eliminated ~~and hence~~, with malfunction sources ~~are~~ being precluded. The disadvantage in this known solution is however that in the replacement process of a used filter element by a new one, the device housing of the cooling unit must be opened; ~~this~~. This opening is accompanied by a corresponding expenditure of time, ~~and when~~. When the used filter element is removed from the device housing of the cooling unit, fluid components also end up on the outside; ~~this~~. This placement can lead to contamination with the corresponding post-cleaning process.

CH 533 246 discloses a device for storing, filtering, and cooling of a fluid medium, especially for a hydraulic system, with a fluid container, ~~in~~. In a vertical through opening surrounded by the jacket-shaped container above the fan ~~there being~~, a deflection housing ~~which~~ holds a filter through which flow takes place from top to bottom, ~~which~~ and forms an annular cooling channel with the container and through which a stream of the filtered fluid flows from bottom to top. ~~Furthermore, the~~ The connecting lines emerging from its top end are connected to the container such that the fluid flow, which is now directed down, remains in the action region of the cooling channel. These connecting lines together with a connection for the oil return from the hydraulic system form arms with which the deflection housing can be supported and mounted on the top of the container.

~~On the basis of this prior art, therefore the~~ Summary of the Invention

~~An object of this the present invention is to further improve the known cooling devices while provide an improved cooling device retaining their conventional advantages such that they are, being compact and light-weight in design, that eliminating complex piping between the cooling unit and filter unit is eliminated, and that preventing contamination in the replacement of the respective filter element can be prevented.~~

~~This object is basically achieved by a cooling device with the features specified in claim 1 in its entirety.~~

~~In that, as specified in the characterizing part of claim 1, where the device housing of the cooling unit has at least one overhanging support arm, via which the respective. The filter unit is connected to the cooling unit via that support arm to carry fluid, from the cooling unit to the filter unit and vice versa. The filter unit, with the filter element, is located outside of the actual device housing of the cooling unit, and still integrally connected by way of the support arm to the latter cooling housing. With the support arm solution as claimed in the of the present invention, it is possible to separate the filter unit with the respective filter element from the cooling unit without in the process having to open the device housing of the cooling unit, and since. Since the cooling unit remains on site, for example, on a hydraulic machine, the filter unit can be moved with the respective filter element for a replacement process to a suitable location, where the contamination which arises arising in the process of replacing the filter element is of no concern. The unused and newly inserted filter element is then moved back onto the support arm by way of the filter unit, and the. The cooling device together with the filtering process can then be started up again.~~

Since the support arm can be a one-piece component of the cooling unit with its device housing, complex piping together with the pertinent sealing systems is omitted and the fluid paths in particular can be kept short; ~~this.~~ This arrangement is favorable for the entire cooling device in terms of energy balance. Although the filter housing itself is no longer directly an integral component of the device housing of the cooling unit, but is located externally by ~~way of~~ the support

arm, the total structural weight is reduced ~~and in~~. In addition to a compact construction, the cooling device ~~as claimed in the~~ of the present invention is also economical to produce and, as already indicated, economical to maintain, since complex after-cleaning due to overflowing hydraulic medium on the cooling device at any rate is not necessary.

In one preferred embodiment of the cooling device ~~as claimed in the~~ of the present invention, the filter unit is located in the flow direction of the fluid, downstream from the cooling unit, so that the filter element is thermally protected. By preference, the cooling unit is made as a plate-shaped finned radiator ~~so that especially this~~. This plate configuration is especially advantageous when the installation spaces are kept flat. ~~By preference the~~ Preferably, the device housing is composed of sheet metal parts, and due to this modular design the production costs can be cut. ~~But it~~ It is also possible to make the finned radiator as a casting, especially as an aluminum diecasting.

By using suitable bypass valves, the cooling device can be adapted to the most varied volumetric flows with the result that the cooling device can be used in a wide range of applications with different orders of magnitude of fluid volumetric flows, without the need for structural changes. Moreover, it has proven especially environmentally friendly to make the respective filter element out of materials which can be completely incinerated, so that residue-free disposal is for the most part achieved.

To improve the cooling performance, a motor-fan unit which increases the required air throughput in the finned radiator and which thus leads to improved radiator results is connected to the cooling unit, especially to its front side.

If in the region of the connecting cover on the support arm a fouling indicator is mounted, it ~~provides information~~ is provided regarding the degree of fouling of the filter element ~~which in~~. In the clogged or almost clogged state and therefore fouled state, the filter element is to be replaced by a respective new one. This replacement takes place quickly ~~and in a manner easy to install by~~ loosening a screw connection between the filter housing and the cover part ~~which is~~ securely located on the support arm. In this way, stationary installation of the cooling device on a hydraulic unit can

also be achieved in the mobile domain, and replacement. Replacement of the respective filter element can take place at some other suitable location, where overflowing fluid contamination is of no concern.

~~\_\_\_\_\_ The cooling device as claimed in the invention will be detailed below using one embodiment as shown in the drawings. The figures are \_\_\_\_\_~~ Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment of the present invention.

#### Brief Description of the Drawings

\_\_\_\_\_ Referring to the drawings which form a part of this disclosure:

FIG. 1 is a schematic and, not to scale.

FIG. 1 ~~\_\_\_\_\_ shows a~~ perspective view of the front of the a cooling device, according to one embodiment of the present invention;

FIG. 2 ~~\_\_\_\_\_ shows is~~ a perspective view of the back of the cooling device, of FIG. 1;

FIGS. 3 and 4 ~~show partially in a~~ are partial, front, elevational views in section, partially in a front view, illustrating the fluid guidance within the filter element over the assignable support arm, in the cooling device of FIG. 1;

FIGS. 5, 6, and 7 ~~show in a~~ are partial, perspective views of various bypass valve solutions, to the extent they are used in the cooling device as claimed in the invention, of FIG. 1; and

FIG. 8 ~~shows is~~ a hydraulic circuit diagram showing the basic structure of the overall cooling device in the form of a hydraulic circuit diagram FIG. 1.

### Detailed Description of the Invention

The cooling device has a cooling unit 10 through which a fluid to be cooled, in particular hydraulic oil, can flow, and a filter unit 12 for filtration of this fluid. As FIGS. 1 to 4 show in particular, the cooling unit 10 and the filter unit 12 are integrally connected to each other via a support arm 14 with an internal fluid guide 16, ~~the~~. The support arm 14 preferably being is an integral component of the device housing 18 of the cooling unit 10. According to the embodiment shown in the drawings, the filter unit 12 is located in the flow direction of the fluid (hydraulic medium) downstream from the cooling unit 10.

~~Furthermore, as~~ As shown in FIG. 2, the cooling unit 10 is made as a plate-shaped, finned radiator. To guide the cooling air, the plate radiator has fins 20 ~~which are~~ folded up in a zig-zag shape ~~and which between themselves~~. Between the fins, the fins border fluid routing channels 22 ~~which are~~ used to transport the fluid to be cooled. The direction of air guidance through the cooling unit 10 runs perpendicular to the plane of FIGS. 1 and 2 ~~and~~, with the actual fluid transport direction ~~run~~extending transversely thereto, that is, in the plane of the figures. ~~Furthermore, the~~ The stacked fluid routing channels 22 discharge on either side into the fluid collecting spaces 24, 26. These collecting spaces 24, 26 form elongated fluid-carrying spaces which extend along the two longitudinal sides of the cooling unit 10. The structure of these finned radiators is in general conventional, so that it is ~~no longer detailed here~~ not described in detail, but is only described to the extent necessary for explanation of the structure of the ~~solution as claimed in the~~ present invention. The device housing 18 ~~proper~~ in this embodiment is composed of individual sheet metal parts; ~~but it~~. It is also possible to produce it as an aluminum casting. If the device housing 18 is composed of sheet metal parts, it is held together via the corresponding weld connections (not shown);).

The filter unit 12 on the outer peripheral side is ~~made~~ formed essentially cylindrical, ~~and fluid~~. Fluid supply 28 (FIG. 3) takes place in the upper edge area of the filter element 30 ~~which is~~ held in a pot-shaped filter housing 32 of the filter unit 12. The direction of flow of dirty fluid through the filter element 30 is from outside to inside, ~~so that fluid~~. Fluid removal or discharge 34 takes place by ~~way of~~ the interior of the filter element 30. (FIG. 4). The actual filter element 30

~~which can consist~~be formed of conventional filtration materials and, for example, as a pleated hollow cylindrical filter mat ~~surrounds~~surrounding a middle support tube, is received in the pot-shaped filter housing 32 from the top, ~~and by.~~ By filtering out dirt from the fluid (hydraulic medium) via the filter element 30, it is ensured that the cleaned fluid cannot form deposits in the connected hydraulic unit in such a way that operation of the entire hydraulic system is compromised.

As is to be seen in particular in FIGS. 3 and 4, ~~and~~ viewed in the direction of ~~looking at~~ FIGS. 3 and 4 from left to right, cooled fluid medium flows into the shaft-like fluid collecting space 24, ~~and.~~ Fluid collected from therein space 24 flows via the internal fluid guide 16 of the support arm 14 to the filter unit 12. These inflow conditions are shown in FIG. 3. The fluid which has been cleaned by the filter element 30 is relayed via the discharge 34 and in turn via the internal fluid guide 16 of the support arm 14 into a collecting tube 36 within the collecting space 24, ~~and in this respect fluid.~~ Fluid guidance of the supply 28 and discharge 34 are located separately and next to each other is achieved. ~~As furthermore follows from these figures, the.~~ The pot-like filter housing 32 on its upper end has an external thread 38 which can be fixed ~~over or coupled to~~ the internal thread section 40 of a cover part 42 ~~on the latter.~~ This cover part 42 ~~which extends from the outside over the upper area of the filter housing 32 and is in turn an integral component of the support arm 14.~~ In the middle, the cover part 42 is penetrated by a fouling indicator 44 ~~which provides~~providing information about the state of fouling of the filter element 30. These fouling indicators 44 are conventional in the field of hydraulics so that they are ~~no longer~~not described in detailed here. ~~Furthermore, the.~~ The cooling unit 10 on its one front side is provided with a motor-fan unit 46 which improves the air throughput between the free intermediate spaces of the fins 20 of the cooling unit 10.

As FIG. 5 ~~furthermore~~ shows, on the bottom of the collecting pipe 36 ~~there is,~~ a combined replenishing and check valve 48 ~~which.~~ Valve 48 is spring-loaded as a check valve in one direction allowsallowing fluid routing to the tank, ~~and in.~~ In this way, valve 48 forms protection against an overpressure, ~~and in.~~ In the other direction, valve 48 serves as a replenishing valve ~~it is possible for~~allowing the fluid to be able to subsequently flow into the collecting pipe 36 coming from the

tank. For this replenishment function, a head part 50 lifts off a contact plate 52 ~~which has~~having a fluid guide in the middle and ~~additionally is being~~ held by the compression spring 54 in its closed position, as shown in FIG. 5.

In the same region as the combined replenishing and check valve 48 ~~there is~~, another spring-loaded check valve 56, ~~which, is~~ located in the fluid supply 28 in the fluid direction upstream from the filter element 30, and protects the fluid cooling circuit to the tank T. As FIG. 7 ~~furthermore~~ shows, on the side opposite the cooling unit 10 ~~there now is likewise and~~ on the bottom end of the fluid collecting space 26, a thermobypass valve 58 ~~which is~~ provided internally with an expansion element 60. These thermobypass valves 58 are conventional, so that their structure is not ~~further detailed here.~~described in detail. The thermobypass valve 58 is used at low fluid temperatures to directly enable fluid supply ~~while bypassing to bypass~~ the cooling unit 10 and to flow to the filter unit 12, specifically by ~~way of~~ the bypass channels 62 ~~which run~~extending parallel to the fins 20 and ~~are~~ located subjacent to the ~~latter.~~fins. If at this point the fluid heats up due to operation of the hydraulic system (not shown), the expansion element 60 expands ~~and, as heating increases, closes to close~~ the bypass channels 62 so that with increasing heating of the fluid most of it is cooled by ~~way of~~ the fluid routing channels 22 of the cooling unit 10 and ~~in this way is~~ supplied to the filter unit 12 ~~in which with~~ the medium ~~which has been being~~ cooled in this way flows and flowing into the longitudinal shaft-shaped fluid collecting space 24.

For suitable fluid guidance, the cooling unit 10 in the fluid collecting spaces 24 and 26 ~~furthermore~~ has the corresponding fluid connection sites, ~~and furthermore there can be connection.~~ Connection sites for connection of measuring units can also be provided, for example, for detecting the temperature of the hydraulic medium. Viewed in the direction of ~~looking at~~ FIG. 1, the shaft-like collecting space 26 at top left has at least one connection site 64 for the dirty fluid ~~which is to be cooled.~~ Subjacent thereto (see FIG. 2) there is a connection site 66 for connection of a temperature detection unit ~~which is (not shown).~~ On the opposite side, the longitudinal shaft 24 has two return lines 68 ~~which are used to~~ remove cooled fluid before running through the filter unit 12. These amounts of fluid can be used for special tasks which are not further specified for a hydraulic system. The subjacent connection sites 70 are used to

connect a hydraulic suction pump ~~which is (not shown and which also ensures)~~ ensuring hydraulic circulation for the cooling unit 10 and the filter unit 12. The respective connection sites 70 as the supply of a suction pump ~~which is (not shown)~~ are located in the fluid direction downstream from the filter element 12 in the collecting space 24. The hydraulic circuit diagram illustrated in FIG. 8 clearly shows the aforementioned fluid guides and circuits, as well as the essential components of the cooling device.

While one embodiment has been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

COOLING DEVICEAbstract of the Disclosure

A cooling device includes a cooling unit (10) through which a fluid to be cooled in particular hydraulic oil, can flow. The unit has a housing (18) and at least one filter unit (12) for filtering the fluid. The housing (18) of the cooling unit (10) includes at least one overhanging support arm (14) establishing fluid communication to and from the corresponding filter unit (12) and the cooling unit (10). The filter unit (12) with the filter element is then arranged outside the actual housing of the cooling unit (10), while being connected in an integrated manner to it by the support arm (14).